TECHNICAL MEMORANDUMS

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THE BELGIAN AEROTECHNICAL LABORATORY AT RHODE-SAINT-GENÈSE

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

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THE BELGIAN AEROTECHNICAL LABORATORY AT RHODE-SAINT-GENÈSE.*

The Buildings

The buildings comprise three parts:

The double floor north wing containing the offices, the library, the drawing office and the conference room;

The large hall containing the two-meter tunnel;

The one floor south wing reserved for the metal and wood workshops, the store and tool room, and the power room.

The Northern Wing

This part of the building, flanked by two fore-parts, comprises the director's office, separated from the secretary's office by a waiting room; the photographic laboratory and the dark-room, the small mechanical workshop, the radio service and the chemical laboratory.

The conference room is located in one of the fore-parts. It is lighted by three large bays and can accommodate 200 persons. It also contains cinematographic and epidiascopic projection apparatus.

On the first floor, above the conference room, there is a garret which is used as a store-room for models; a library con-

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taining an important compilation of publications, mostly issued by foreign laboratories, and the principal aeronautical magazines issued throughout the world.

Besides, there are the offices of the chief engineers, the calculator's office, the drawing office and the blueprinting room.

A passage connects this floor with the experimental chamber of the wind tunnel.

The Southern Wing

The southern wing contains a cloak room and a dining room for the workmen, a mechanical workshop, with the following machines:

A big lathe, pitch of centers 310 mm (12.2 in.), distance between centers 2.65 m (8.69 ft.);

A pulley lathe, pitch of centers 215 mm (8.46 in.), distance between centers 0.8 m (2.62 ft.);

A small lathe, pitch of centers 150 mm (5.91 in.), distance between centers 0.8 m (2.62 ft.);

A drilling machine, pitch of centers 1.5 m (4.92 ft.), and maximum depth of bore 700 mm (27.56 in.);

A shaping machine, length 750 mm (29.53 in.), and width of stroke 650 mm (25.59 in.);

A big planing machine, length 2.9 m (9.51 ft.), width of table 820 mm (23.28 in.), and height 550 mm (21.65 in.);

A boring machine, maximum diameter 50 mm (1.97 in.);

A grinding machine, distance between centers 600 mm (23.62 in.), grinding up to a diameter of 260 mm (10.24 in.);

A tool grinding machine;

A milling machine;

A metal saw;

A grinding wheel;

A surface plate of 1.5 m (4.92 ft.) by 0.8 m (2.62 ft.);

Three work-benches, six vices and other small tools for current use. Besides the usual work-benches the wood workshop also contains a band-saw, a combined machine (planing, smooth planing, boring, tenoning and circular saw), a vertical spindle moulding machine and two grinding wheels.

A central store has been installed between the two workshops. It contains the necessary stocks of wood, metals and raw materials. A power room is also located in this wing, right hand of the 460 HP. motor.

The Electric Installation

The three-phase current is supplied to the station at the tension of 6000 volts. The tension is brought down to 220 volts by the following static transformers:

1) 7.5 KVA transformer for lighting purposes;
2) 400 KVA transformer for the wind tunnel;
3) 50 KVA transformer for the driving force;

4) 200 KVA transformer, which may be connected in parallel with the former.

The installation includes the following motors:

1) A 460 HP. motor for the wind tunnel (to be described later);

2) A 30 HP. motor for the small tunnel;

3) A continuous current motor-generator set for charging of batteries and for reduced propeller tests;

4) The various motors used in the workshops for the operation of the machine-tools.

The Wind Tunnel

The central hall measures 60 by 15 m (196.85 x 49.21 ft.), and has a maximum height of 13 m (42.65 ft.).

The wind tunnel is located along the axis of the parallelepipedic part of this hall. It is carried by 16 concrete pillars and cast in one piece with the entrance cone, the Eiffel experimental chamber and the exit cone.

The 460 HP. motor is placed at the end upon a steel frame let into a block of concrete independent of the tunnel and the building. The axis of the motor is 5.75 m (18.86 ft.) above ground.

The entrance cone and the exit cone on the propeller level have a diameter of 6 m (19.68 ft.). The entrance cone at the experimental chamber has a diameter of two meters, which is the dimension of the air flow.

The experimental chamber, 6.5 m by 6.5 m (21.33 x 21.33 ft.),

is 5 m (16.4 ft.) high. The generatrices of the exit cone, which is 30 m long, make an angle of 3° 30' with its axis, thus forming a truncated cone which has a 7 degrees opening at its upper end.

The entrance cone has been extended in the inner part of the chamber by a wooden cylinder 2.1 m (6.89 ft.) long. The exit cone has also been extended by a truncated concrete part terminated by a bell-mouthed collecting ring. Between this bell mouth and the cylindrical extension of the entrance cone there is a free space, 1.05 m (3.44 ft.) long.

The models are placed in the extension of the entrance cone and connected by thin wires with the balance frame.

A honeycomb had first been provided at the entrance of the experimental chamber. It was formed by 4 sets of streamlined blades, assembled on a quincunx pattern, two vertical and two horizontal series alternating. The blades had a thickness of 15 mm. This honeycomb has been replaced by another honeycomb, placed in the entrance cone. It is formed out of sheet iron, 2 mm (.079 in.) thick, and 30 cm (11.81 in.) deep, assembled at 30 cm distance.

The air is circulated by a 6-blade propeller, protected by a steel net of 7 cm (2.76 in.) cells and wires of 3 mm (.118 in.) diameter.

The 460 HP. Motor of the Large Wind Tunnel

It is an alternating-current commutator motor built by the Ateliers et Forges de Jeumont (workshops and forges of Jeumont).

The 220 volt three-phase current passes first through an induction regulator, which allows regulation of the tension within the limits of 220 plus or minus 180 volts; each phase of this regulator carries a stationary and a rotating winding which may be either opposed or put in phase. This movement is controlled by an auxiliary motor operated from the experiment chamber.

The current then passes through the stator and finally through a phase auto-transformer which turns it into six-phase current.

This six-phase current is supplied to the entrance cone.

There also exists another induction regulator, shunting the motor, which is only used for high speeds.

The speed of rotation may reach 400 revolutions per minute. It is constantly shown by a voltmeter, calibrated for revolutions and placed in the experimental section. This voltmeter is operated by a dynamo-tachometer with permanent magnets, driven by the motor itself.

The Wind Tunnel Balance

Schematically the wind tunnel balance has been designed as follows:

The lift Fz is decomposed into Fz_1 and Fz_2, which are, like Fx, measured through the intermediary of links by

by means of three independent levers placed upon a platform above the tunnel.

The supports of the levers for measuring Fz_1 and Fz_2 are maintained parallel by means of a parallelogram. The variation of the angle of incidence of the model is obtained by turning a screw, which raises the support of Fz_2.

The measures of Fx, Fz_1 and Fz_2 are obtained by successively fastening two of the beams and by balancing the third one by means of weights up to 0.5 kg (1.1 lb.), using a spring dynamometer to balance the remaining fraction of weight. The speed, corresponding to each weighing, is also measured. The angle of incidence of the model may be read on a scale showing the angle of incidence of the frame. However, the angle of incidence, formed by frame and model, has to be measured before fixing the model. Moreover, the angle of incidence of the model may slightly vary owing to the elastic deflection of the wires, which fix it to the frame. Therefore a small mirror, mounted on the model, reflects a spot of light upon a scale, thus allowing one to determine, for each measure, the corresponding correction of the angle of incidence.

It is possible to determine the measures for each beam to an accuracy of plus or minus 10 grams (.35 oz.) at the present state of the balance; but this accuracy may still be increased.

The diagram of the moments is directly deduced from the

preceding measures. It is obtained through the measures Fz_1 and Fz_2 with the condition, however, that the model be so fixed upon the frame, that while the angle of incidence varies, the axis of rotation coincides with a known point of the model, which is generally a point of the drag axis.

The distinguishing feature of this balance is the way of fixing the model. This latter is connected with the balance through a metallic frame, which is outside the air flow; all the intermediate gearings are also outside the air flow.

This way of fixing the model to the frame has been adopted because of its great strength and particularly so in view of high speed tests.

Eight steel wires of 1 mm (.04 in.) diameter are generally used to fix the model to the frame. These wires are carefully counterweighed and the method of support is as a rule the same for the various models.

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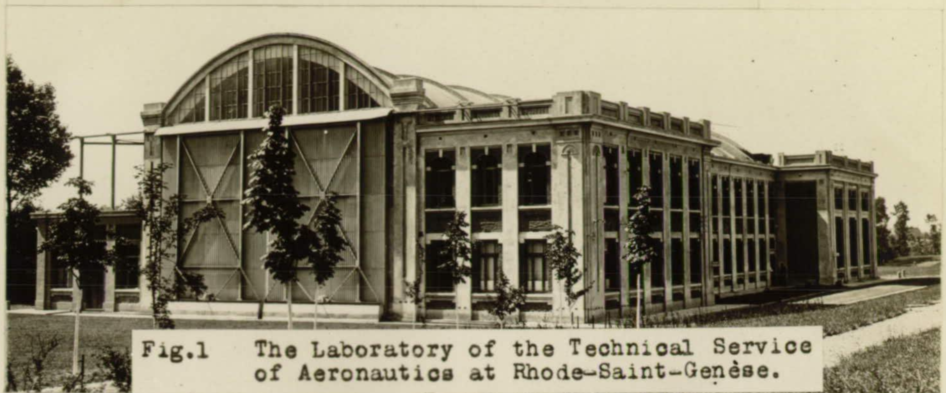

Fig.1 The Laboratory of the Technical Service of Aeronautics at Rhode-Saint-Genèse.

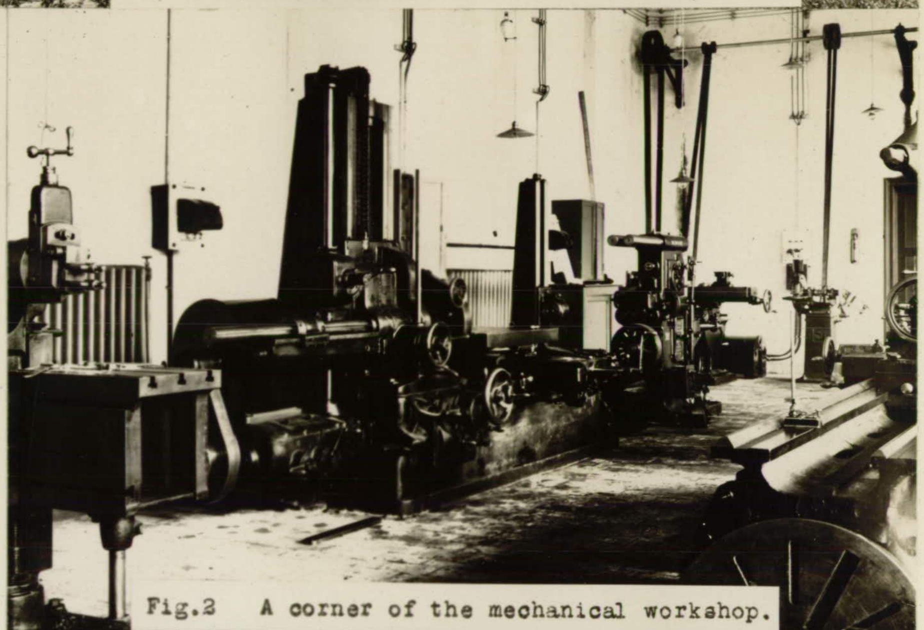

Fig.2 A corner of the mechanical workshop.

Fig.3 An airplane model in the wind tunnel.

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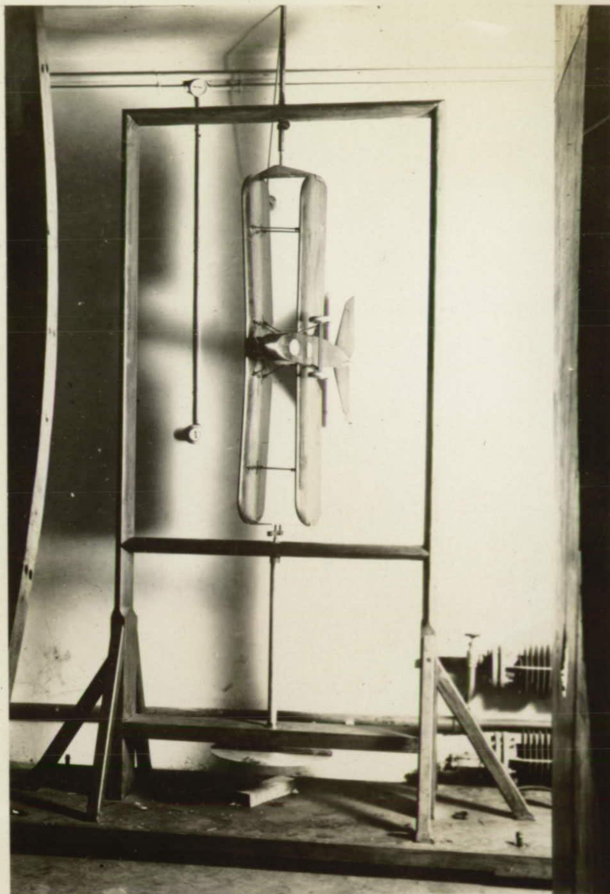

Fig.4 A device for the determination of the center of pressure.

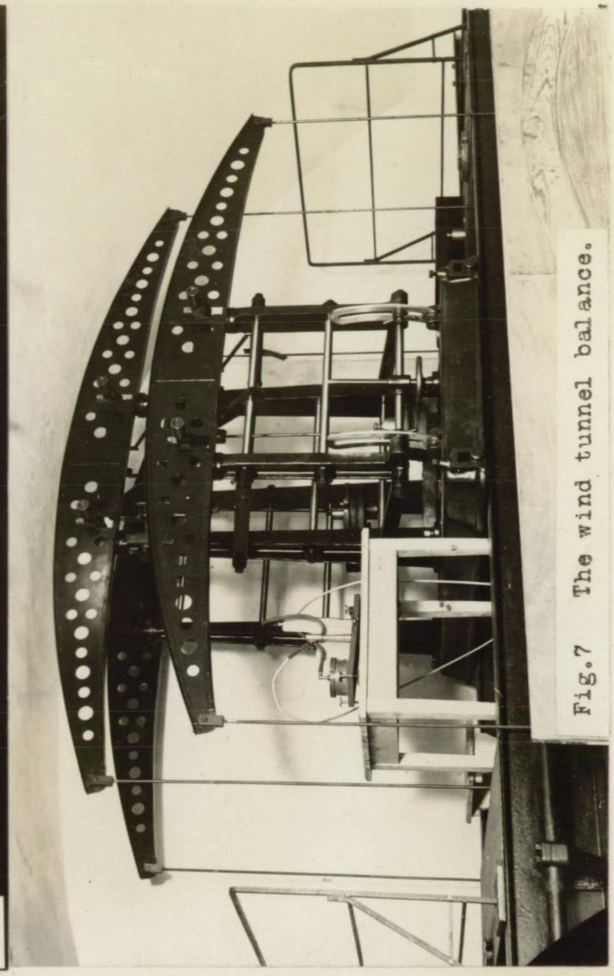

Fig.7 The wind tunnel balance.

Fig.5 The end of the exit cone, the 460 HP. motor and the motor frame.

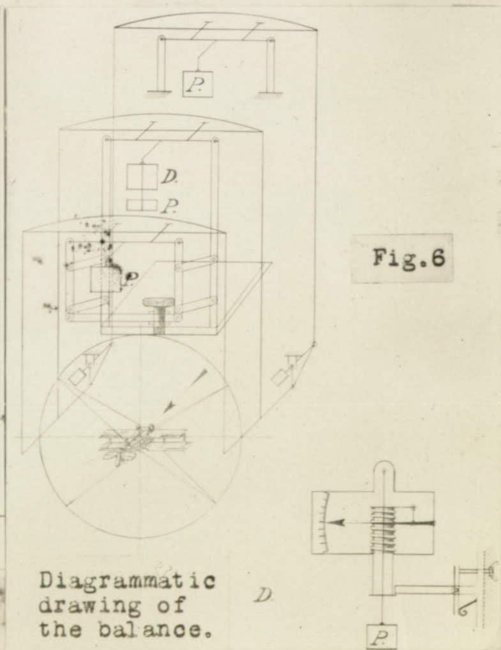

Fig.6

Diagrammatic drawing of the balance.